

DIHeDRAL: Downhole Regolith Interrogation with Helium-Assisted DRill And LIBS, Phase I

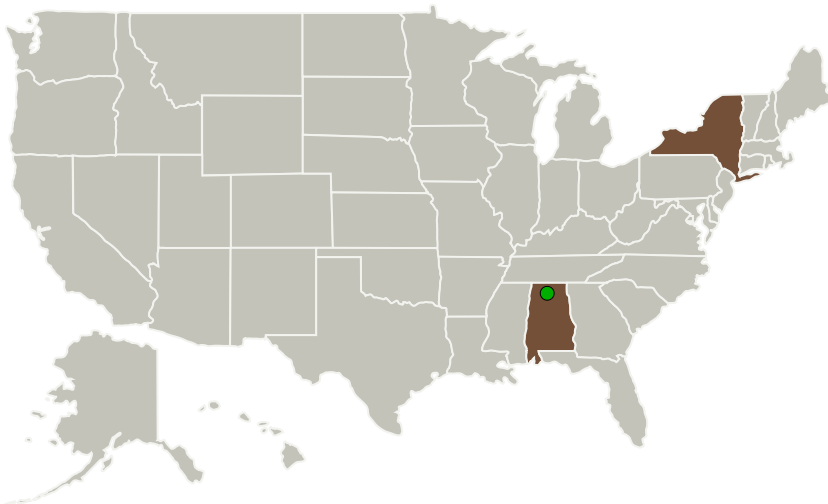
Completed Technology Project (2010 - 2010)



Project Introduction

Future landed robotic missions to the lunar poles will seek to characterize the properties of subsurface regolith. Current instruments for such in-situ analysis, however, require that geological samples be brought to the surface by a sample acquisition tool and subsequently processed and presented to the analyzer. This model has significant limitations with regard to science yield: evaporation of volatile molecules before reaching the instrument, loss of stratigraphic information, sample bias, and cross-contamination. Furthermore, sophisticated sample acquisition, processing and handling mechanisms required to operate in uncontrolled, dusty environments are expensive and failure-prone. We therefore propose an alternative: bring the instrument to the sample. Specifically, we propose development of a fiber-coupled laser-induced breakdown spectrometer (LIBS) system, integrated into a 3m-class drill. LIBS uses a high-energy laser pulse to create a plasma on the surface of the material under test; the atomic emissions are collected by a spectrometer and yield elemental composition and basic molecular information. DIHeDRAL will allow profiling of an entire borehole wall, centimeter by centimeter, 360 degrees, from the top to the bottom. The proposed Phase I work focuses on the downhole sensor head, including modeling, analysis, and breadboarding of the sensor head optics. The resulting validated sensor head design will be fed forward into Phase II, which will culminate in the integration and test of a simplified DIHeDRAL brassboard prototype to a depth of 1m in Honeybee's dedicated drill testing thermal-vacuum chamber.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Honeybee Robotics, Ltd.	Lead Organization	Industry	Pasadena, California
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	New York

Project Transitions

▶ **January 2010:** Project Start

✓ **July 2010:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140014>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Honeybee Robotics, Ltd.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

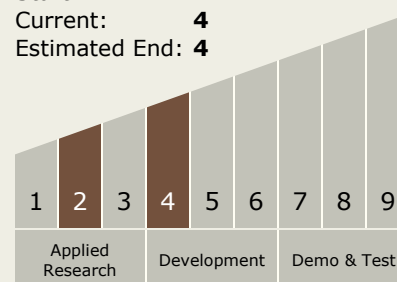
Carlos Torrez

Principal Investigator:

Paolo Moreschini

Technology Maturity (TRL)

Start: 2
Current: 4
Estimated End: 4



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Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.3 In-Situ Instruments and Sensors
 - └ TX08.3.3 Sample Handling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System